2607

Department of
Mines and Petroleum Resources
ASSESSMENT REPORT
NO. 2607 MAP

REPORT ON THE INDUCED POLARIZATION AND RESISTIVITY SURVEY ON THE RIVIERA OPTION, PROJECT 83, PORT HARDY AREA, NANAIMO M.D., B.C. FOR PHELPS DODGE CORPORATION OF CANADA LTD.

92L/11W

BY

PHILIP G. HALLOF, Ph.D.

ASHTON W. MULLAN, P.ENG.

NAME AND LOCATION OF PROPERTY:

RIVIERA OPTION, PORT HARDY AREA,

NANAIMO MINING DIVISION, B.C. 50°N, 128°W - NE

DATE STARTED: NOVEMBER 29, 1969

DATE FINISHED: FEBRUARY 28, 1970

TABLE OF CONTENTS

McPHAR GEOPHYSICS

NOTES ON THE THEORY, METHOD OF FIELD OPERATION, AND PRESENTATION OF DATA FOR THE INDUCED POLARIZATION METHOD

Induced Polarization as a geophysical measurement refers to the blocking action or polarization of metallic or electronic conductors in a medium of ionic solution conduction.

This electro-chemical phenomenon occurs wherever electrical current is passed through an area which contains metallic minerals such as base metal sulphides. Normally, when current is passed through the ground, as in resistivity measurements, all of the conduction takes place through ions present in the water content of the rock, or soil, i.e. by ionic conduction. This is because almost all minerals have a much higher specific resistivity than ground water. The group of minerals commonly described as "metallic", however, have specific resistivities much lower than ground waters. The induced polarization effect takes place at those interfaces where the mode of conduction changes from ionic in the solutions filling the interstices of the rock to electronic in the metallic minerals present

in the rock.

The blocking action or induced polarization mentioned above, which depends upon the chemical energies necessary to allow the ions to give up or receive electrons from the metallic surface, increases with the time that a d. c. current is allowed to flow through the rock; i. e. as ions pile up against the metallic interface the resistance to current flow increases. Eventually, there is enough polarization in the form of excess ions at the interfaces, to appreciably reduce the amount of current flow through the metallic particle. This polarization takes place at each of the infinite number of solution-metal interfaces in a mineralized rock.

When the d. c. voltage used to create this d. c. current flow is cut off, the Coulomb forces between the charged ions forming the polarization cause them to return to their normal position. This movement of charge creates a small current flow which can be measured on the surface of the ground as a decaying potential difference.

From an alternate viewpoint it can be seen that if the direction of the current through the system is reversed repeatedly before the polarization occurs, the effective resistivity of the system as a whole will change as the frequency of the switching is changed. This is a consequence of the fact that the amount of current flowing through each metallic interface depends upon the length of time that current has been passing through it in one direction.

The values of the per cent frequency effect or F. E. are a measurement of the polarization in the rock mass. However, since the measurement of the degree of polarization is related to the apparent resistivity of the rock mass it is found that the metal factor values or M. F. are the most useful values in determining the amount of polarization present in the rock mass. The MF values are obtained by normalizing the F. E. values for varying resistivities.

The induced polarization measurement is perhaps the most powerful geophysical method for the direct detection of metallic sulphide mineralization, even when this mineralization is of very low concentration. The lower limit of volume per cent sulphide necessary to produce a recognizable IP anomaly will vary with the geometry and geologic environment of the source, and the method of executing the survey. However, sulphide mineralization of less than one per cent by volume has been detected by the IP method under proper geological conditions.

The greatest application of the IP method has been in the search for disseminated metallic sulphides of less than 20% by volume. However, it has also been used successfully in the search for massive sulphides in situations where, due to source geometry, depth of source, or low resistivity of surface layer, the EM method can not be successfully applied. The ability to differentiate ionic conductors, such as water filled shear zones, makes the IP method a useful tool in checking EM

anomalies which are suspected of being due to these causes.

In normal field applications the IP method does not differentiate between the economically important metallic minerals such as chalcopyrite, chalcocite, molybdenite, galena, etc., and the other metallic minerals such as pyrite. The induced polarization effect is due to the total of all electronic conducting minerals in the rock mass. Other electronic conducting materials which can produce an IP response are magnetite, pyrolusite, graphite, and some forms of hematite.

In the field procedure, measurements on the surface are made in a way that allows the effects of lateral changes in the properties of the ground to be separated from the effects of vertical changes in the properties. Current is applied to the ground at two points in distance (X) apart. The potentials are measured at two other points (X) feet apart, in line with the current electrodes is an integer number (n) times the basic distance (X).

The measurements are made along a surveyed line, with a constant distance (nX) between the nearest current and potential electrodes. In most surveys, several traverses are made with various values of (n); i.e. (n) = 1, 2, 3, 4, etc. The kind of survey required (detailed or reconnaissance) decides the number of values of (n) used.

In plotting the results, the values of the apparent resistivity, apparent per cent frequency effect, and the apparent metal factor

measured for each set of electrode positions are plotted at the intersection of grid lines, one from the center point of the current electrodes and the other from the center point of the potential electrodes. (See Figure A.) The resistivity values are plotted above the line as a mirror image of the metal factor values below. On a second line, below the metal factor values, are plotted the values of the per cent frequency effect. In some cases the values of per cent frequency effect are plotted as superscripts of the metal factor value. In this second case the frequency effect values are not contoured. The lateral displacement of a given value is determined by the location along the survey line of the center point between the current and potential electrodes. The distance of the value from the line is determined by the distance (nX) between the current and potential electrodes when the measurement was made.

The separation between sender and receiver electrodes is only one factor which determines the depth to which the ground is being sampled in any particular measurement. The plots then, when contoured, are not section maps of the electrical properties of the ground under the survey line. The interpretation of the results from any given survey must be carried out using the combined experience gained from field results, model study results and theoretical investigations. The position of the electrodes when anomalous values are measured is important in the interpretation.

In the field procedure, the interval over which the potential differences are measured is the same as the interval over which the electrodes are moved after a series of potential readings has been made. One of the advantages of the induced polarization method is that the same equipment can be used for both detailed and reconnaissance surveys merely by changing the distance (X) over which the electrodes are moved each time. In the past, intervals have been used ranging from 25 feet to 2000 feet for (X). In each case, the decision as to the distance (X) and the values of (n) to be used is largely determined by the expected size of the mineral deposit being sought, the size of the expected anomaly and the speed with which it is desired to progress.

The diagram in Figure A demonstrates the method used in plotting the results. Each value of the apparent resistivity, apparent metal factor, and apparent per cent frequency effect is plotted and identified by the position of the four electrodes when the measurement was made. It can be seen that the values measured for the larger values of (n) are plotted farther from the line indicating that the thickness of the layer of the earth that is being tested is greater than for the smaller values of (n); i. e. the depth of the measurement is increased. When the F. E. values are plotted as superscripts to the MF values the third section of data values is not presented and the F. E. values are not contoured.

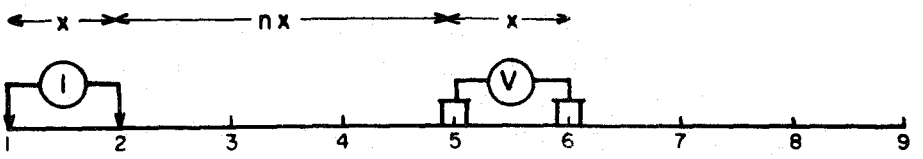
The actual data plots included with the report are prepared utilizing an IBM 360/75 Computer and a Calcomp 770/763 Incremental Plotting System. The data values are calculated, plotted, and contoured according to a programme developed by McPhar Geophysics. Certain symbols have been incorporated into the programme to explain various situations in recording the data in the field.

The IP measurement is basically obtained by measuring the difference in potential or voltage (ΔV) obtained at two operating frequencies. The voltage is the product of the current through the ground and the apparent resistivity of the ground. Therefore in field situations where the current is very low due to poor electrode contact, or the apparent resistivity is very low, or a combination of the two effects; the value of (ΔV) the change in potential will be too small to be measurable. The symbol "TL" on the data plots indicates this situation.

In some situations spurious noise, either man made or natural, will render it impossible to obtain a reading. The symbol "N" on the data plots indicates a station at which it is too noisey to record a reading. If a reading can be obtained, but for reasons of noise there is some doubt as to its accuracy, the reading is bracketed in the data plot ( ).

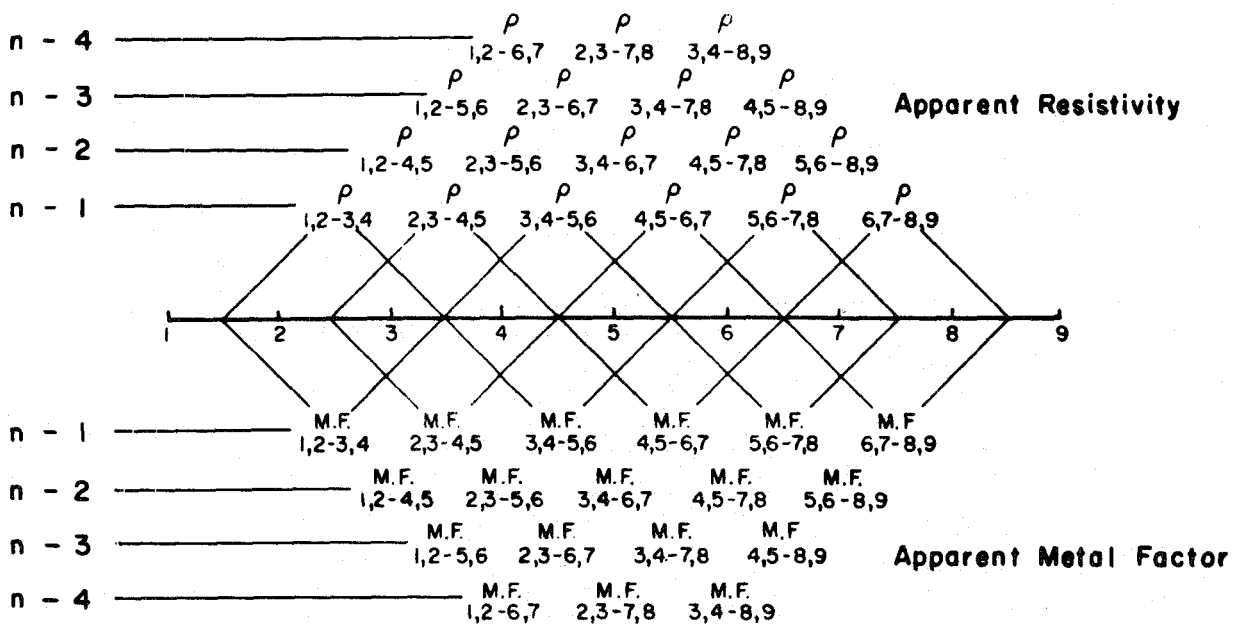
In certain situations negative values of Apparent Frequency Effect are recorded. This may be due to the geologic environment or spurious electrical effects. The actual negative frequency effect value recorded is indicated on the data plot, however the symbol "NEG" is

METHOD USED IN PLOTTING DIPOLE-DIPOLE INDUCED POLARIZATION AND RESISTIVITY RESULTS



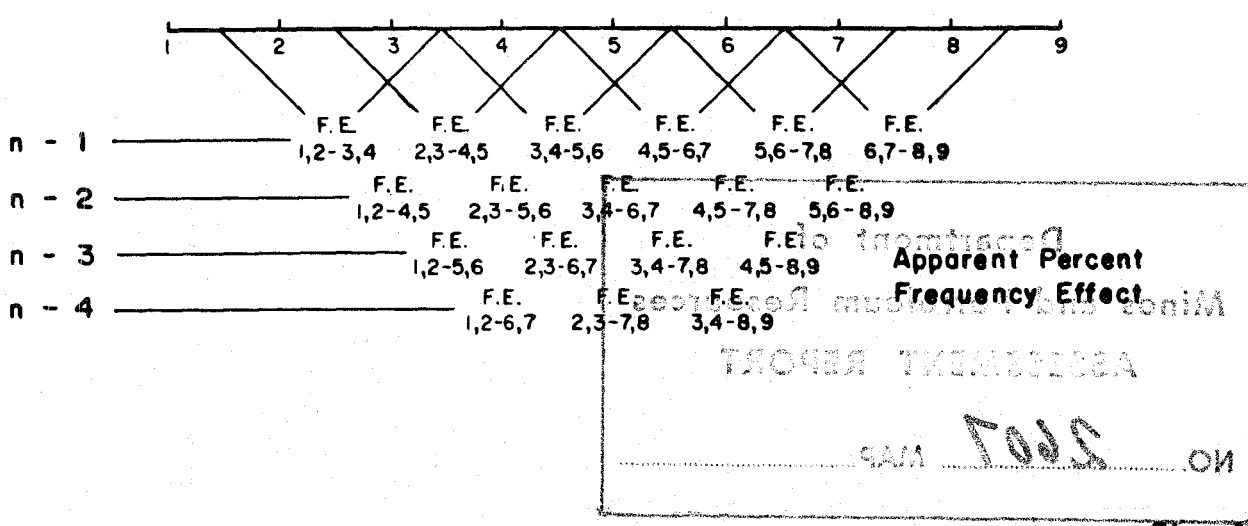
Stations on line

x = Electrode spread length
n = Electrode separation



Apparent Resistivity

Apparent Metal Factor



Apparent Percent Frequency Effect

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Fig. A

indicated for the corresponding value of Apparent Metal Factor. In contouring negative values the contour lines are indicated to the nearest positive value in the immediate vicinity of the negative value.

The symbol "NR" indicates that for some reason the operator did not attempt to record a reading although normal survey procedures would suggest that one was required. This may be due to inaccessible topography or other similar reasons. Any symbol other than those discussed above is unique to a particular situation and is described within the body of the report.

McPHAR GEOPHYSICS LIMITED

REPORT ON THE
INDUCED POLARIZATION
AND RESISTIVITY SURVEY
ON THE
RIVIERA OPTION, PROJECT 83,
PORT HARDY AREA, NANAIMO M.D., B.C.
FOR
PHELPS DODGE CORPORATION OF CANADA LTD.

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1. INTRODUCTION

At the request of Mr. J. Ratcliffe, geophysicist for the Company, a reconnaissance induced polarization and resistivity survey has been completed on the Riviera Option in the Port Hardy Area of Vancouver Island for Phelps Dodge Corporation of Canada Ltd. The property is located approximately 20 miles south of Port Hardy. The centre of the property is situated in the northeast quadrant of the 1 degree quadrilateral whose southeast corner is at 128° west longitude and 50° north latitude in the Nanaimo Mining District.

The grid is in the general area of the Utah Construction Co. copper-molybdenum discovery. The pertinent geological sequence is as follows. The Karmutsen Formation is a great plateau of basaltic lavas, overlain by the Quatsino Formation and Bonanza subgroup of late Triassic age. The Bonanza subgroup consists of felsitic lavas, tuffs, breccias and ignimbrites, altered basaltic to andesitic tuff, breccia and lava interbedded with Lower Jurassic greywacke and argillite.

The ore deposits at the Utah Construction property are copper-molybdenum stockworks in silicified andesitic volcanics and greywackes of the Lower Bonanza Formation. The stockworks are similar to a porphyry copper type of deposit, but they are not within an intrusive complex. The source of the ore is thought to be granite and porphyritic plugs nearby, so local structure and stratigraphy are important ore controls. In the Utah deposit the Bonanza rocks are hydrothermally altered and pyritized for several thousand feet outward from the ore zone. The ore averages 0.52% copper and 0.25% molybdenum.

The induced polarization and resistivity survey was carried out to try to locate mineralization similar to the Utah type of copper-molybdenum stockworks. Surface exploration is hampered by heavy overburden.

The IP survey was carried out with a McPhar variable frequency IP unit operating at 0.3 and 5.0 cps. Field work was performed in November and December, 1969, January and in late February, 1970, on the following claims:

Har Group:	4, 5, 6, 7, 8, 9, 17, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 33, 34, 35, 36, 39, 41, 42, 43, 44.

These claims are all located in the Nanaimo Mining District and are assumed to be owned or held under option by the Phelps Dodge Corporation of Canada Ltd.

2. PRESENTATION OF RESULTS

The induced polarization and resistivity results are shown on the following data plots in the manner described in the notes preceding this report.

Line	Electrode Intervals	Dwg.No.
0+00	400 feet	IP 5407-1
0+00	200 feet	IP 5407-2
0+00	100 feet	IP 5407-3
8+00S	400 feet	IP 5407-4
16+00S	400 feet	IP 5407-5
24+00S	400 feet	IP 5407-6
24+00S	400 feet	IP 5407-7
24+00S	400 feet	IP 5407-8
24+00S	200 feet	IP 5407-9
24+00S	100 feet	IP 5407-10
32+00S	400 feet	IP 5407-11
32+00S	400 feet	IP 5407-12
40+00S	400 feet	IP 5407-13
48+00S	400 feet	IP 5407-14
56+00S	400 feet	IP 5407-15

Enclosed with this report is Dwg. I.P.P. 4607, a plan map of the grid at a scale of 1" = 400'. The definite and possible induced polarization anomalies are indicated by solid and broken bars respectively on this plan map as well as the data plots. These bars represent the surface projection of the anomalous zones as interpreted from the location of the transmitter and receiver electrodes when the anomalous values were measured.

Since the induced polarization measurement is essentially an averaging process, as are all potential methods, it is frequently difficult to exactly pinpoint the source of an anomaly. Certainly, no anomaly can be located with more accuracy than the spread length; i.e. when using 400'

spreads the position of a narrow sulphide body can only be determined to lie between two stations 400' apart. In order to locate sources at some depth, larger spreads must be used, with a corresponding increase in the uncertainties of location. Therefore, while the centre of the indicated anomaly probably corresponds fairly well with source, the length of the indicated anomaly along the line should not be taken to represent the exact edges of the anomalous material.

The location of survey lines relative to claim boundaries and the names and relative position of the claims, are based upon maps submitted by the Phelps Dodge Corporation of Canada Ltd., who also supplied the information regarding the drill hole.

References: G.S.C. Paper 70-1, Part A - Report of Activities April to October 1969, Page 44 - Northern Vancouver Island by J.E. Muller. Canadian Mining Journal, May 1969, Page 66 - Geology and Mineral Possibilities of Vancouver Island by J.E. Muller and D.J.T. Carson.

3. DISCUSSION OF RESULTS

The resistivities in the survey area are generally low, but a line of demarcation between low and higher resistivities can be drawn east of the base line. This line could indicate a change of rock type.

It has been reported that a hole drilled to a depth of +250' on Line 0 ended in overburden. This must be considered in evaluating the geophysical data.

Line 0

Line 0 was surveyed with 400' electrode intervals and the anomaly which was located on this survey was detailed with 200 foot and 100 foot electrode intervals.

The anomaly located with 400' intervals is definite from 4W to 4E with weaker extensions from 4W to 8W and from 4E to 8E. The top of the source is less than 1 unit (400') below surface. One or more parallel lines to the north of Line 0 would be of value in determining the extent of the source of the anomaly.

The 200' detail located a weak anomaly on n = 3 and n = 4 from 0 to 4E. This may be the top of the source causing the anomaly on the 400' survey.

The 100' detail located a weak anomaly between 5W and 3+50E. This anomaly is not necessarily related to the anomaly found on the 400' survey, and may reflect only conductive overburden.

Line 8S

The line is very weakly anomalous from the west end to 16E, with narrow zones of increased magnitude from 10W to 14W and from 0 to 4E or 8E. From 16E to the eastern end of the line, the MF effects are still anomalous and weak, but generally higher in magnitude than to the west of 16E.

Line 16S

With the exception of Line 0, the strongest anomalies located by the survey are on this line. The anomaly from 12W to 28W is definite from 12W to 26W and probable to 28W. The main source is at depth relative to the electrode interval, with a shallow weaker extension to the east.

There is a definite anomaly from 0 to 10W. The pattern suggests a flat-lying source at a depth of approximately half of the electrode

interval, or 200'. The MF values in the centre of this type of pattern are low, although the MF values here are unusually low. The row of negative values between the two anomalies suggests a local contact problem (although survey procedures have been checked, and they do not appear to be at fault). Hence the two western anomalies may be co-extensive. However, if the overburden is more than 200' thick, the top of the source cannot be in bedrock. Bedrock depth should be determined, and if it is less than 200', the anomaly should be detailed with 200' electrode intervals.

There is a definite anomaly from 20E to 30E with weaker extensions to 12E. The source of this anomaly is at depth relative to the electrode interval.

A deep, possible anomaly was located from 40E to 46E.

Line 24S

The line is weakly anomalous over most of its length. From 12W to the western end, the magnitude of the anomaly is greater than over the remainder of the line. From 12W to 48E the line is anomalous on n = 4 and for the most part on n = 3. The magnitude of the anomaly increases at depth from 40E to 44E.

The line was re-surveyed from 0 to 40W to check the noisy readings on the first survey. These later readings have been used in this evaluation.

The western end of the line was checked with 200' electrode intervals. A very weak anomaly was located from 4W to 11W, but it is too weak to be of any great significance.

The 100' survey located a weak anomaly at depth relative to the

electrode interval from 11W to 12W. A second anomaly extends to the east from 6+50W and is incomplete.

Line 32S

The line is anomalous from 28W to 48E, particularly on n = 3 and n = 4, with increased magnitude from 24W to 8E. The section from 2W to 2E is definite. The western portion of the line was re-surveyed in January 1970, as were Line 16S and portions of Line 40S and Line 24S. A different type of receiver was used with better noise dampening properties, so the figures from the January survey are considered to be more reliable than the noisy readings of the earlier survey.

Line 40S

The line is weakly anomalous from 14E to 56E, especially on n = 3 and n = 4. Resistivities increase on n = 1 and n = 2 from 40E to the east, suggesting a change in rock type.

Line 48S

The resistivities on Line 48S are, for the most part, consistently higher than on any of the lines to the north. There are three weak anomalies, from 4E to 16E, from 24E to 32E and from about 46E to at least 52E.

Line 56S

The resistivities are high on this line also. There is an incomplete probable anomaly at the east end of the line from 24E.

4. SUMMARY AND RECOMMENDATIONS

The anomalies located by the IP survey are broad, with considerable range in magnitude, and are fairly typical of disseminated mineralization. The major exceptions to this are Line 0 and Line 16S, where the anomalies are definite and may represent more concentrated mineralization.

There would be little advantage in detailing anomalies with shorter spreads, since the anomalies generally are strongest on n = 3 and n = 4 and therefore are presumed to be at depths of a few hundred feet. It is recommended that a few vertical holes be drilled to: (a) determine the thickness of the overburden; and (b) to determine the source of the anomalies. Suggested locations would be:

1)	Line 16S	-	To check the anomaly under 22W at a vertical depth of 800 to 1,000 feet.
2)	Line 8S	-	To check the anomaly under 26E at a vertical depth of 600 to 800 feet.
3)	Line 48S	-	To check the anomaly under 24E at a vertical depth of 800 feet.

McPHAR GEOPHYSICS LIMITED

Philip G. Hallof,
Geophysicist.

A. W. Mullan,
Geologist.

PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
A. W. MULLAN
Expiry Date: May 28th, 1970

Dated: March 19, 1970

ASSESSMENT DETAILS

PROPERTY: Riviera Project 83

MINING DIVISION: Nanaimo

SPONSOR: Phelps Dodge Corporation of Canada Ltd.

PROVINCE: British Columbia

LOCATION: Port Hardy Area

TYPE OF SURVEY: Induced Polarization

OPERATING MAN DAYS:	66	DATE STARTED:	November 29, 1969
EQUIVALENT 8 HR. MAN DAYS:	99	DATE FINISHED:	February 28, 1970
CONSULTING MAN DAYS:	3	NUMBER OF STATIONS:	275
DRAUGHTING MAN DAYS:	10	NUMBER OF READINGS:	2,214
TOTAL MAN DAYS:	112	MILES OF LINE SURVEYED:	16.8

CONSULTANTS:
A.W. Mullan, 1823 Alderlynne Road, N.Vancouver, British Columbia
Philip G. Hallof, 5 Minorca Place, Don Mills, Ontario.

FIELD TECHNICIANS:
R. Pearson, 7836 Bowcliff Crescent, Calgary, Alberta
W. Parker, Box 340, Choiceland, Saskatchewan.
G. Trefananko, 651 Sheppard Avenue West, Toronto, Ontario.
Plus 13 helpers (See Statement of Cost)

DRAUGHTSMEN:
V. Young, 703 Cortez Avenue, Bay Ridges, Ontario.
B. Marr, 19 Kenewen Court, Toronto 16, Ontario.
N. Lade, 1355 Lakefield Street, Oshawa, Ontario.

McPHAR GEOPHYSICS LIMITED

Philip G. Hallof,
Geophysicist.

Dated: March 19, 1970

PROFESSIONAL ENGINEERS
PROVINCE OF BRITISH COLUMBIA
Expiry Date: February 25, 1971

STATEMENT OF COST

Phelps Dodge Corporation of Canada Ltd.

Riviera Project # 83 - Port Hardy Area, British Columbia

Crew		
18 ½ days Operating	@ $210.00/day	3,885.00
3 ½ days Travel)		
3 ½ days Preparation) 17 days	@ $ 85.00/day	1,445.00
3 days Bad Weather)		
7 days Standby)		
Extra Labour	3,610.00	
Plus Service Charge 20%	722.00	
	4,332.00	4,332.00

Extra Labour - 13 Men

A. Tomkulak, General Delivery, Smithers, British Columbia
D. Shelley, R.R. #4, St. Thomas, Ontario.
J. Blogg, General Delivery, Smithers, British Columbia
P. Egan, General Delivery, Telkwa, British Columbia
H. Parent, General Delivery, Kamloops, British Columbia
R. Theimer, 2683 Ord Road, Kamloops, British Columbia
M. L'Heureux, General Delivery, Kamloops, British Columbia
T. Keehn, 1231 Shubert Drive, Kamloops, British Columbia
L. Ferguson, General Delivery, Kamloops, British Columbia
L. Lapine, General Delivery, Kamloops, British Columbia
M. Bennett, 453 West Battle Street, Kamloops, British Columbia
D. Kushuer, 7756 Muirfield Drive, Vancouver, British Columbia
J. Scragge, McPhar Geophysics Inc. 818 West Miracle Mile, Tucson, Arizona.

Crew Expenses	
Transportation - Ferry	15.00
Vehicle Expense (Tilden, etc.)	675.22
Taxi	15.20
Meals and Accommodation	1,198.35
Vehicle Expense	52.50
Freight and Brokerage	34.97
Telephone and Telegraph	63.25
Supplies	125.29
	2,179.78
Plus 10% Service Charge	217.98
	2,397.76
	$12,059.76

Declared before me at the City of Vancouver, in the Province of British Columbia, this 21st day of April, 1970, A.D.

A Commissioner for taking Affidavits within British Columbia

SUB MINING RECORDER

McPHAR GEOPHYSICS LIMITED

Philip G. Hallof,
Geophysicist.

PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA

Expiry Date: February 28, 1971

Dated: March 19, 1970

CERTIFICATE

I, Philip George Hallof, of the City of Toronto, Province of Ontario, do hereby certify that:

1. I am a geophysicist residing at 5 Minorca Place, Don Mills, (Toronto) Ontario.

2. I am a graduate of the Massachusetts Institute of Technology with a B.Sc. Degree (1952) in Geology and Geophysics, and a Ph.D. Degree (1957) in Geophysics.

3. I am a member of the Society of Exploration Geophysicists and the European Association of the Exploration Geophysicists.

4. I have been practising my profession for ten years.

5. I have no direct or indirect interest, nor do I expect to receive any interest directly or indirectly, in the property or securities of Phelps Dodge Corporation of Canada Ltd., or any affiliate.

6. The statements made in this report are based on a study of published geological literature and unpublished private reports.

7. Permission is granted to use in whole or in part for assessment and qualification requirements but not for advertising purposes.

Dated at Toronto

This 19th day of March 1970

Philip G. Hallof

Philip G. Hallof, Ph.D. Geo. N.Z.

CERTIFICATE

I, Ashton W. Mullan, of the City of Vancouver, in the Province of British Columbia, hereby certify:

1. That I am a geologist and a fellow of the Geological Association of Canada with a business address at Suite 811, 837 West Hastings Street, Vancouver, B.C.

2. That I am registered as a member of the Association of Professional Engineers of the Provinces of Ontario and British Columbia.

3. That I hold a B.Sc. Degree from McGill University.

4. That I have been practising my profession as a geologist for about twenty years.

5. I have no direct or indirect interest, nor do I expect to receive any interest directly or indirectly, in the property or securities of Phelps Dodge Corporation of Canada Ltd., or any affiliate.

6. The statements made in this report are based on a study of published geological literature and unpublished private reports.

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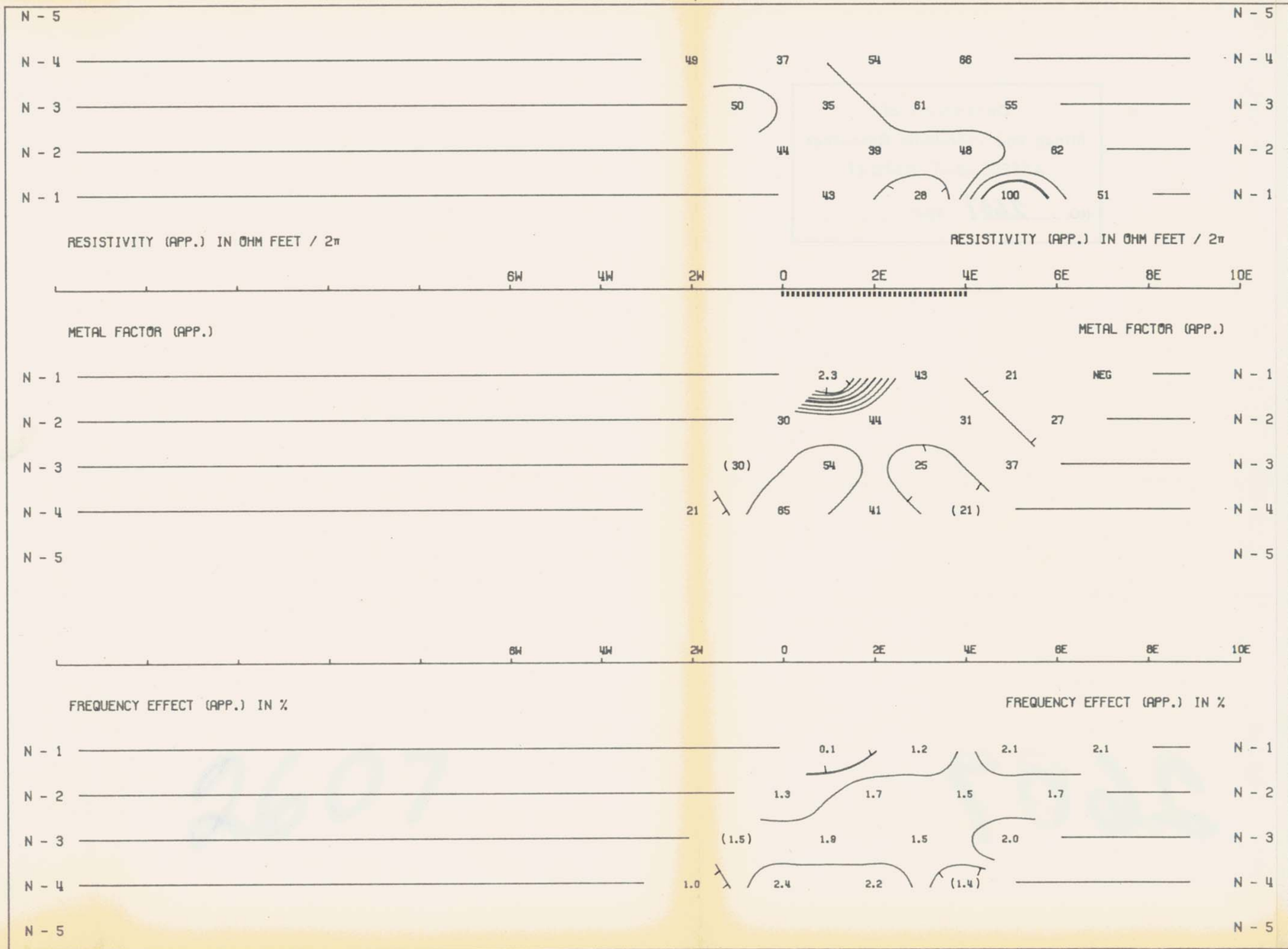
Dated at Toronto

This 19th day of March 1970

PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA

A. W. Mullan, B.Sc., P. Eng.

Copy Date: May 28th, 1970



DWG. NO.- I.P.-5407-2

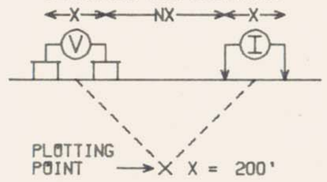
PHELPS DODGE CORPORATION OF CANADA LIMITED

RIVIERA OPTION, PROJECT 83

PORT HARDY AREA, NANAIMO M.D., B.C.

LINE NO.- 0

ELECTRODE CONFIGURATION



SURFACE PROJECTION OF ANOMALOUS ZONES

DEFINITE ——————

PROBABLE ||||||||||||||

POSSIBLE / / / / / /

FREQUENCIES: 0.31-5.0 CPS

DATE SURVEYED: JAN 1970

APPROVED: A.W. Mullan

DATE: Mar 20, 1970

PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA A. W. MULLAN

Expiry Date: May 28th, 1970

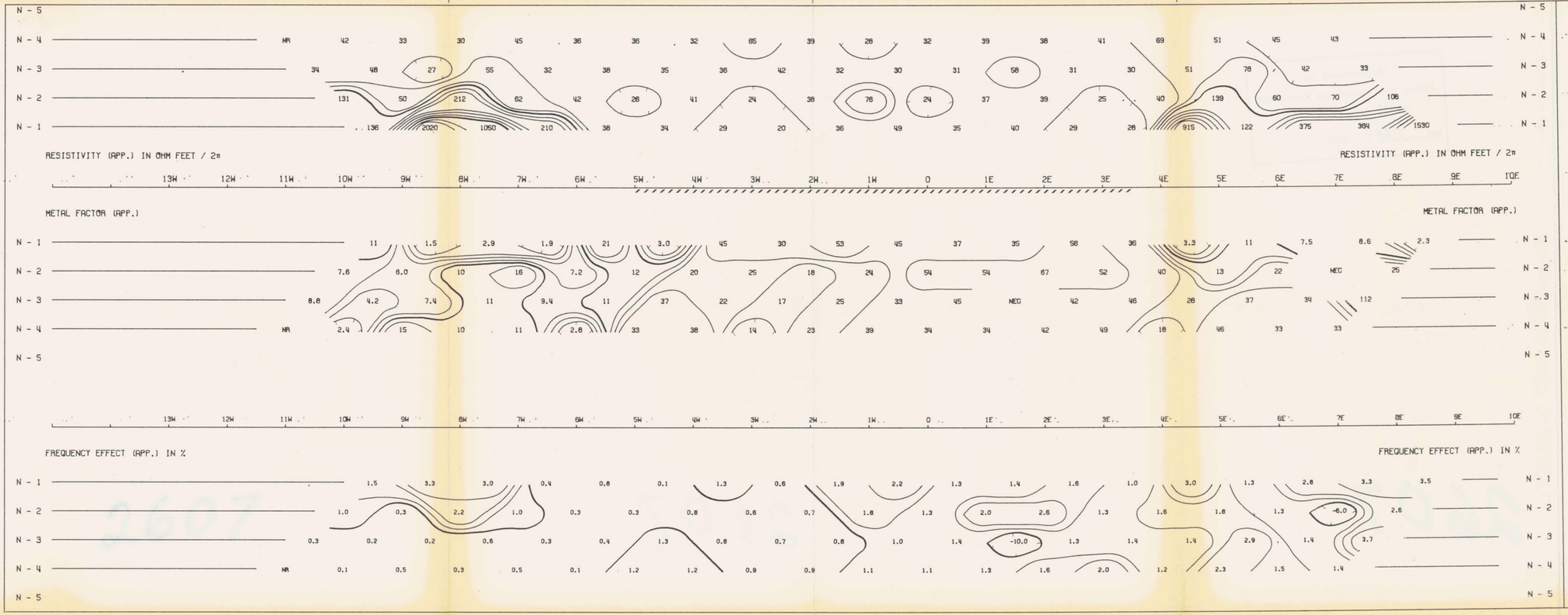
NOTE: CONTOURS AT LOGARITHMIC INTERVALS 1.-1.5-2.-3.-5.-7.5-10

2607

McPHAR GEOPHYSICS

INDUCED POLARIZATION AND RESISTIVITY SURVEY

NOTE: THIS PLOT WAS PRODUCED WITH AN IBM 360/75 COMPUTER AND A CALCOMP PLOTTER



DWG. NO.- I.P.-5407-3

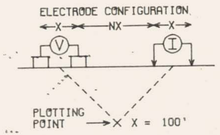
PHELPS DODGE CORPORATION OF CANADA LIMITED

RIVIERA OPTION, PROJECT 83

PORT HARDY AREA, NANAIMO M.D., B.C.

LINE NO.- 0

ELECTRODE CONFIGURATION



SURFACE PROJECTION OF ANOMALOUS ZONES

DEFINITE

PROBABLE

POSSIBLE

FREQUENCIES: 0.31-5.0 CPS

DATE SURVEYED: FEB 1970

APPROVED:

A. W. MULLAN

PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA

DATE: May 13, 1970

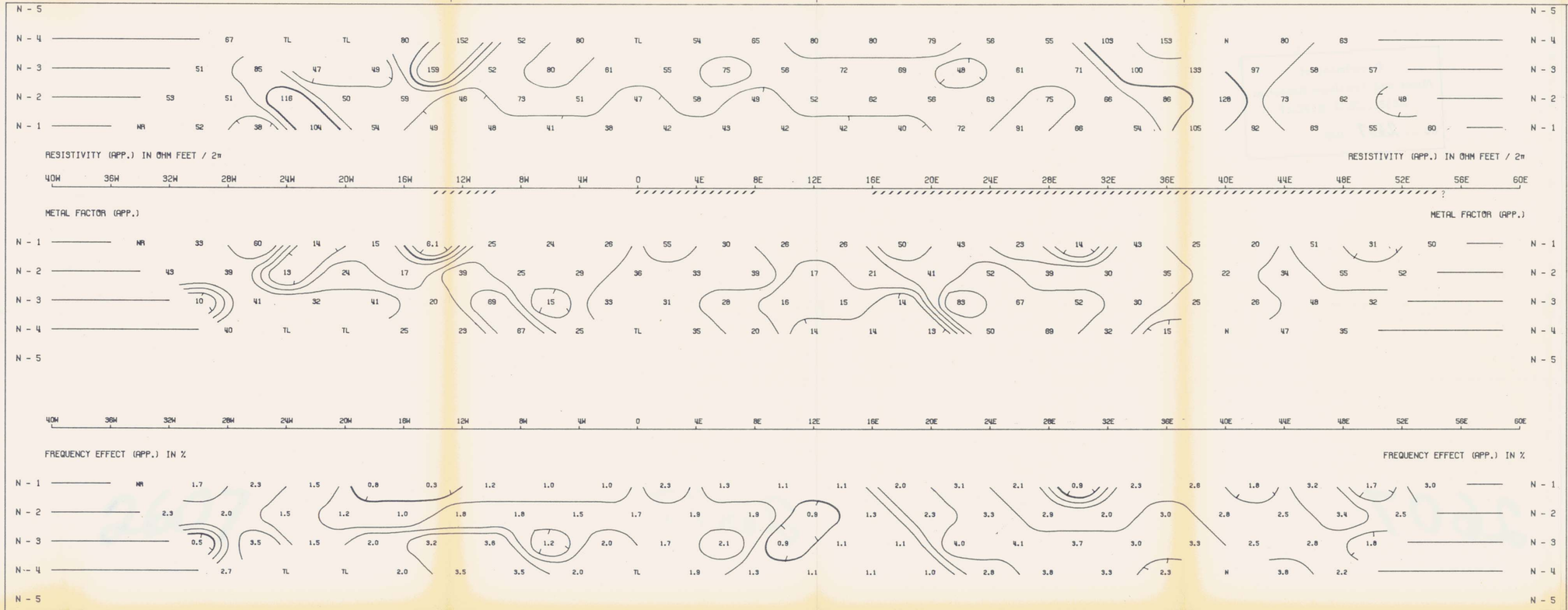
NOTE: CONTOURS AT LOGARITHMIC INTERVALS 1.-1.5-2.-3.-5.-7.5-10

2607

McPHAR GEOPHYSICS

INDUCED POLARIZATION AND RESISTIVITY SURVEY

NOTE: THIS PLOT WAS PRODUCED WITH AN IBM 360/75 COMPUTER AND A CALCOMP PLOTTER



DWG. NO.- I.P.- 5407-4

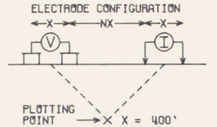
PHELPS DODGE CORPORATION OF CANADA LIMITED

RIVIERA OPTION, PROJECT 83

PORT HARDY AREA, NANAIMO M.D., B.C.

LINE NO.- 8S

ELECTRODE CONFIGURATION



SURFACE PROJECTION OF ANOMALOUS ZONES

DEFINITE ——————

PROBABLE ||||||||||||

POSSIBLE / / / / / /

FREQUENCIES: 0.31-5.0 CPS

DATE SURVEYED: DEC 1969

APPROVED:

A.W. MULLAN

PROFESSIONAL ENGINEER

PROVINCE OF BRITISH COLUMBIA

Expiry Date: May 28th, 1970

NOTE: CONTOURS AT LOGARITHMIC INTERVALS 1.-1.5-2.-3.-5.-7.5-10

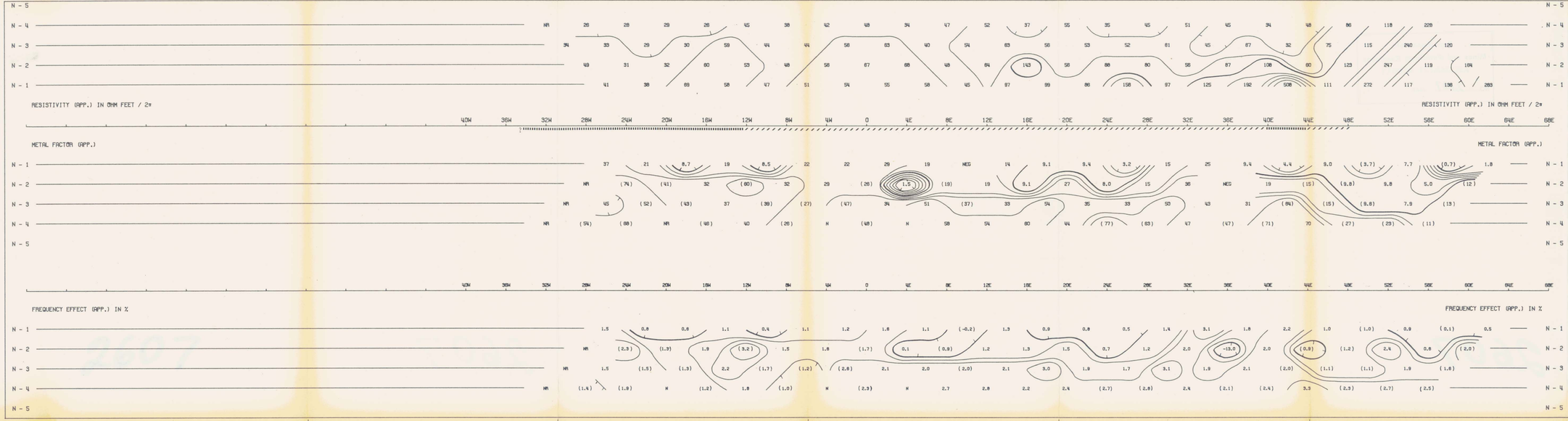
DATE: Mar. 20, 1970

2607

McPHAR GEOPHYSICS

INDUCED POLARIZATION AND RESISTIVITY SURVEY

NOTE: THIS PLOT WAS PRODUCED WITH AN IBM 360/75 COMPUTER AND A CALCOMP PLOTTER



DWG. NO.- I.P.-5407-6

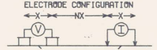
PHELPS DODGE CORPORATION OF CANADA LIMITED

RIVIERA OPTION, PROJECT 83

PORT HARDY AREA, NANAIMO M.D., B.C.

LINE NO.- 24S

ELECTRODE CONFIGURATION



SURFACE PROJECTION OF ANOMALOUS ZONES

DEFINITE

PROBABLE

POSSIBLE

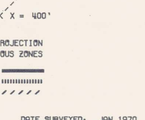
FREQUENCIES: 0.31-5.0 CPS

DATE SURVEYED: JAN 1970

APPROVED:

NOTE: CONTOURS AT LOGARITHMIC INTERVALS 1.-1.5-2.-3.-5.-7.5-10

DATE: May 20/1970

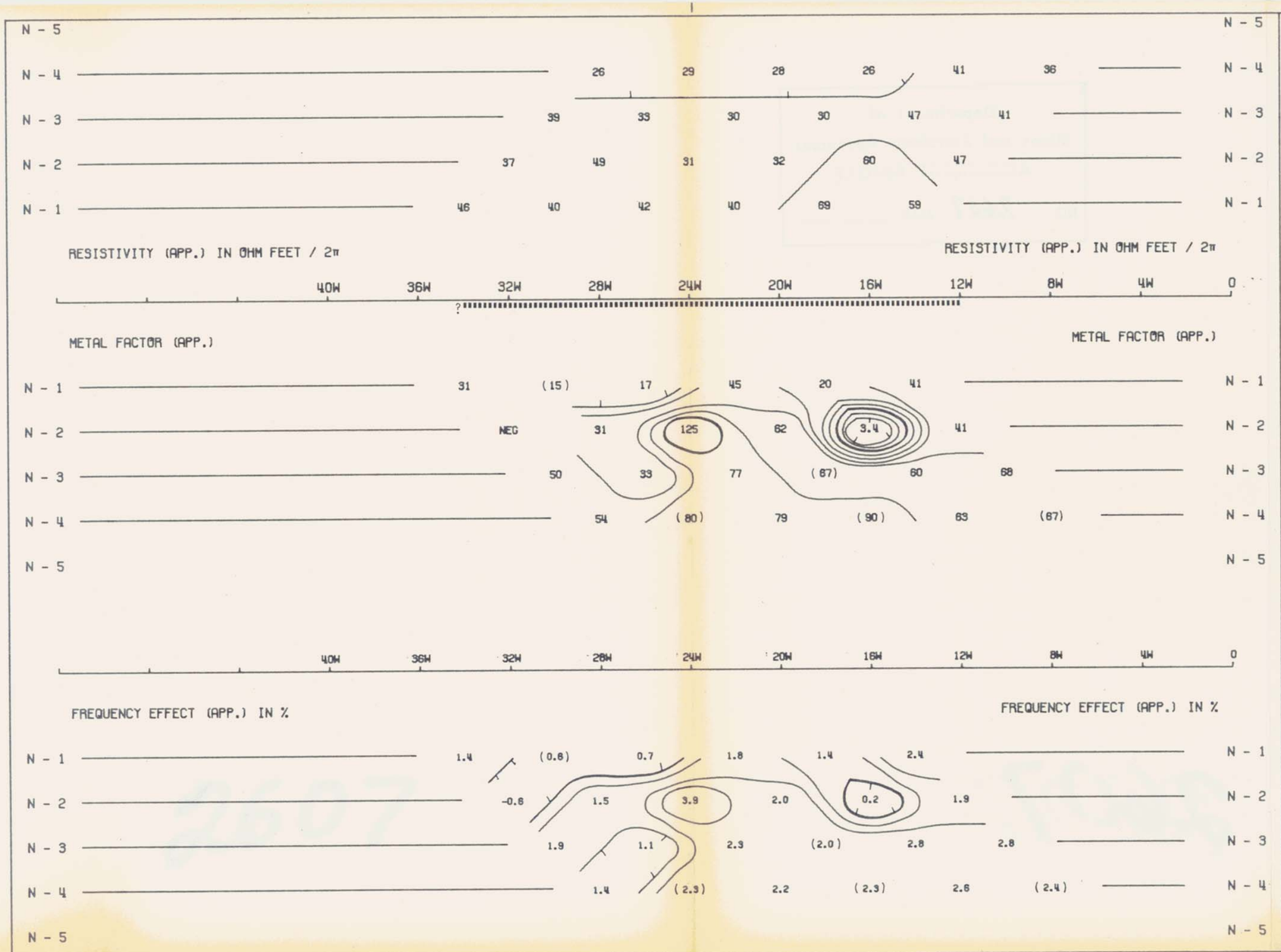


2607

McPHAR GEOPHYSICS

INDUCED POLARIZATION AND RESISTIVITY SURVEY

NOTE: THIS PLOT WAS PRODUCED WITH AN IBM 360/75 COMPUTER AND A CALCOMP PLOTTER



DWG. NO.- I.P.- 5407-7

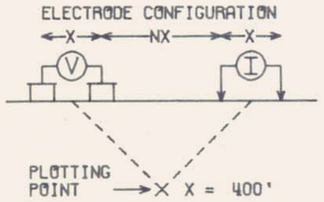
PHELPS DODGE CORPORATION OF CANADA LIMITED

RIVIERA OPTION, PROJECT 83

PORT HARDY AREA, NANAIMO M.D., B.C.

LINE NO.:- 24S

ELECTRODE CONFIGURATION



SURFACE PROJECTION OF ANOMALOUS ZONES

DEFINITE ——————

PROBABLE ··········

POSSIBLE / / / / /

FREQUENCIES: 0.31-5.0 CPS

DATE SURVEYED: JAN 1970

APPROVED: A.W. McLEAN

DATE: Mar 20/1970

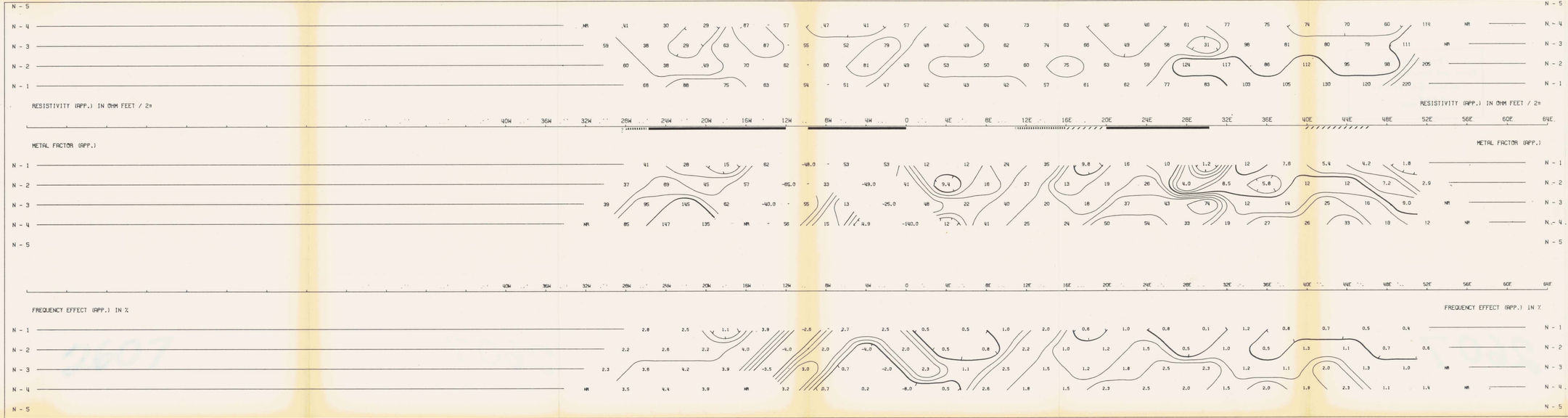
NOTE: CONTOURS AT LOGARITHMIC INTERVALS 1.-1.5-2.-3.-5.-7.5-10

2607

McPHAR GEOPHYSICS

INDUCED POLARIZATION AND RESISTIVITY SURVEY

NOTE: THIS PLOT WAS PRODUCED WITH AN IBM 360/75 COMPUTER AND A CALCOMP PLOTTER



DWG. NO.- I.P.- 5407-5

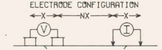
PHELPS DODGE CORPORATION OF CANADA LIMITED

RIVIERA OPTION, PROJECT 83

PORT HARDY AREA, NANAIMO M.D., B.C.

LINE NO.- 165

ELECTRODE CONFIGURATION



SURFACE PROJECTION OF ANOMALOUS ZONES

DEFINITE

PROBABLE

POSSIBLE

FREQUENCIES: 0.31-5.0 CPS

DATE SURVEYED: FEB 1970

APPROVED:

DATE: March 20, 1970

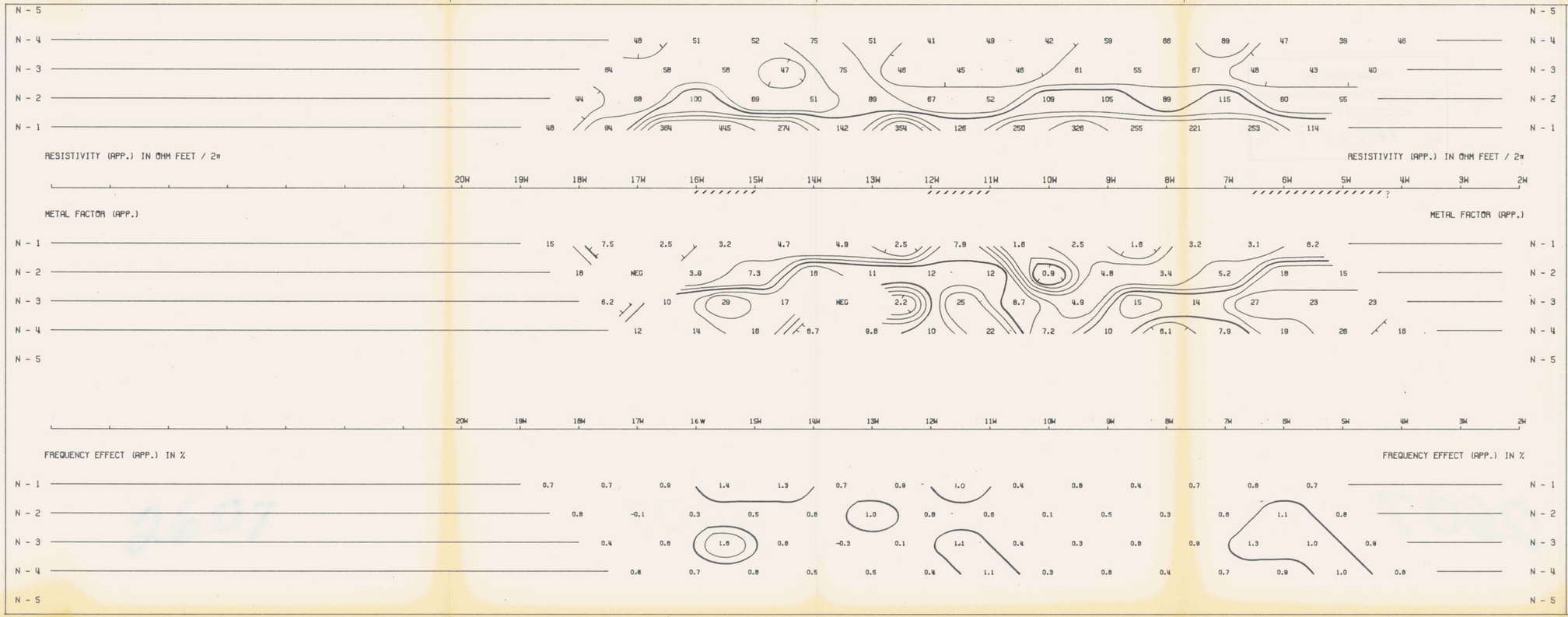
NOTE: CONTOURS AT LOGARITHMIC INTERVALS 1.-1.5-2.-3.-5.-7.5-10

2607

McPHAR GEOPHYSICS

INDUCED POLARIZATION AND RESISTIVITY SURVEY

NOTE: THIS PLOT WAS PRODUCED WITH AN IBM 360/75 COMPUTER AND A CALCOMP PLOTTER



DWG. NO.- I.P.- 5407-10

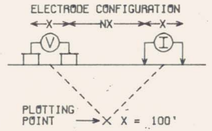
PHELPS DODGE CORPORATION OF CANADA LIMITED

RIVIERA OPTION, PROJECT 83

PORT HARDY AREA, NANAIMO M.D., B.C.

LINE NO.- 24S

ELECTRODE CONFIGURATION



SURFACE PROJECTION OF ANOMALOUS ZONES

DEFINITE

PROBABLE

POSSIBLE

FREQUENCIES: 0.31-5.0 CPS

DATE SURVEYED: JAN 1970

APPROVED:

NOTE: CONTOURS AT LOGARITHMIC INTERVALS 1.-1.5-2.-3.-5.-7.5-10

DATE: Mar 23/1970

PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA A. W. MULLAN 7579

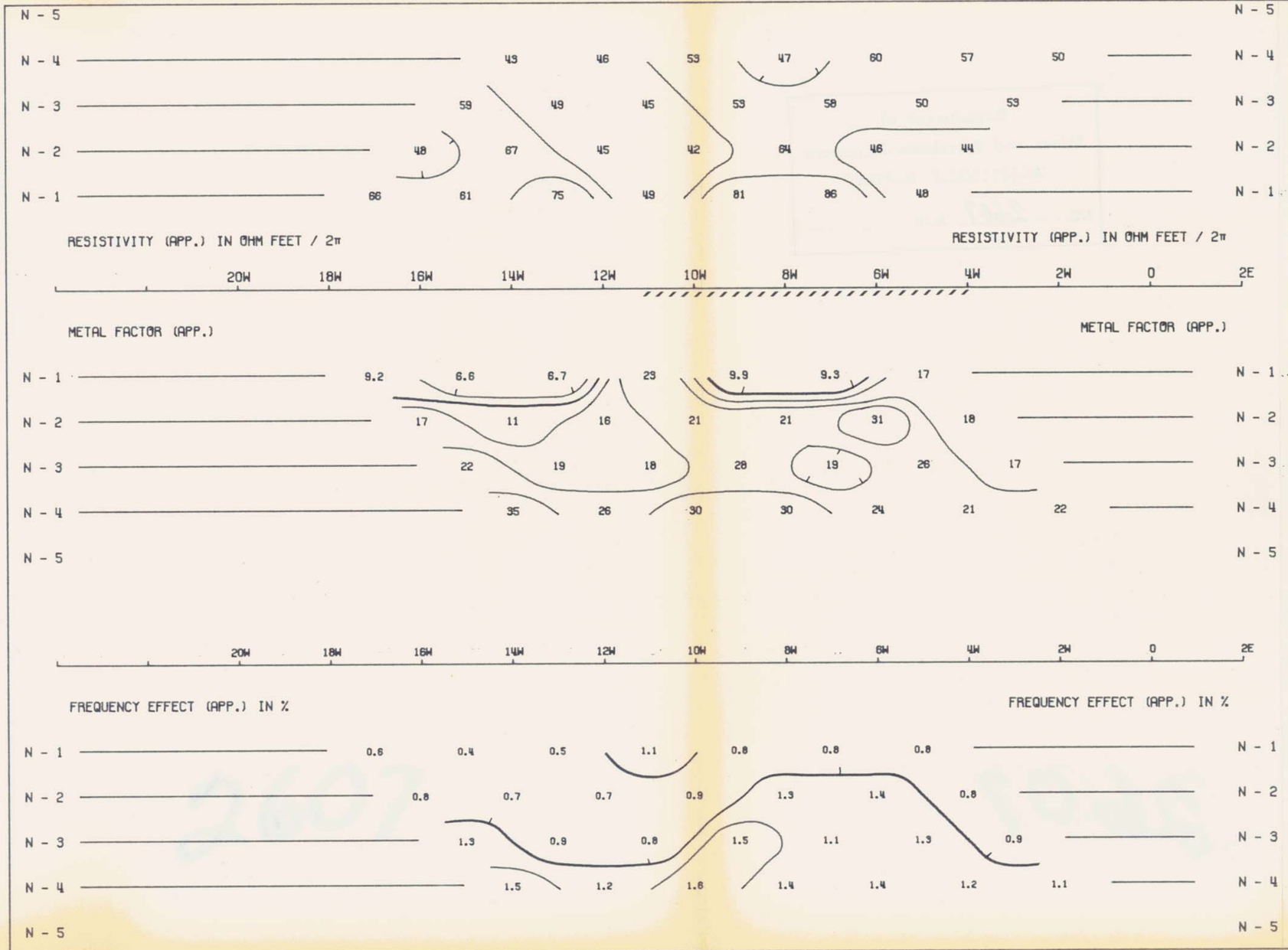
Expiry Date: May 23 h, 1970

2607

McPHAR GEOPHYSICS

INDUCED POLARIZATION AND RESISTIVITY SURVEY

NOTE: THIS PLOT WAS PRODUCED WITH AN IBM 360/75 COMPUTER AND A CALCOMP PLOTTER



DWG. NO.- I.P.- 5407-9

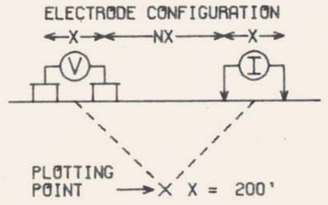
PHELPS DODGE CORPORATION OF CANADA LIMITED

RIVIERA OPTION, PROJECT 83

PORT HARDY AREA, NANAIMO M.D., B.C.

LINE NO.- 24S

ELECTRODE CONFIGURATION



SURFACE PROJECTION OF ANOMALOUS ZONES

DEFINITE

PROBABLE

POSSIBLE

FREQUENCIES: 0.31-5.0 CPS

DATE SURVEYED: JAN 1970

APPROVED:

A. W. MULLAN

DATE: March 20, 1970

PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA

Expiry Date: May 28th, 1970

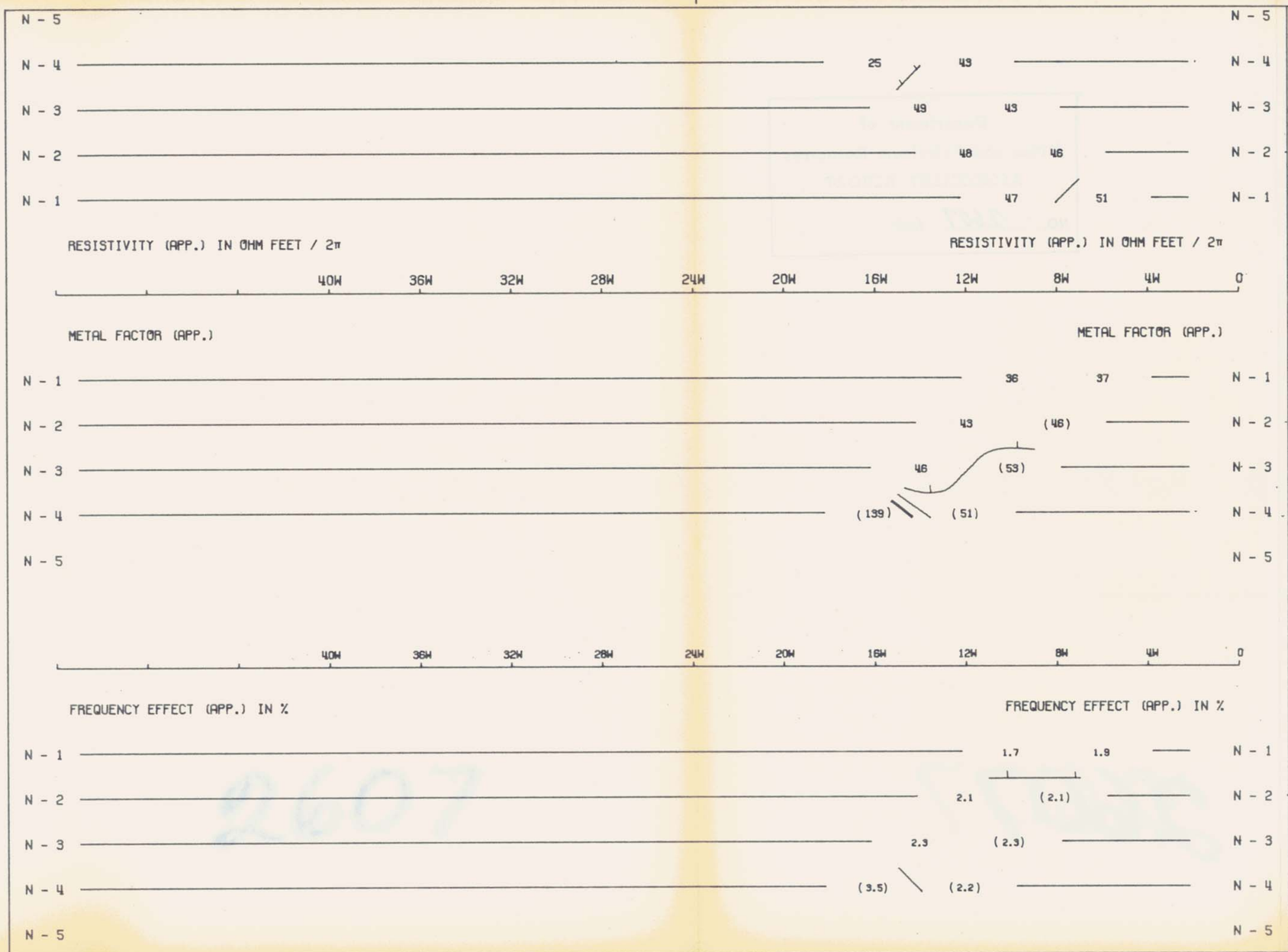
NOTE: CONTOURS AT LOGARITHMIC INTERVALS 1.-1.5-2.-3.-5.-7.5-10

2607

McPHAR GEOPHYSICS

INDUCED POLARIZATION AND RESISTIVITY SURVEY

NOTE: THIS PLOT WAS PRODUCED WITH AN IBM 360/75 COMPUTER AND A CALCOMP PLOTTER



DWG. NO.- I.P.- 5407-8

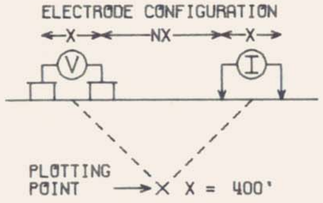
PHELPS DODGE CORPORATION OF CANADA LIMITED

RIVIERA OPTION, PROJECT 83

PORT HARDY AREA, NANAIMO M.D., B.C.

LINE NO.- 24S

ELECTRODE CONFIGURATION



SURFACE PROJECTION OF ANOMALOUS ZONES

DEFINITE ——

PROBABLE ▪▪▪▪▪▪▪▪▪▪▪▪

POSSIBLE / / / / / /

FREQUENCIES: 0.31-5.0 CPS

DATE SURVEYED: JAN 1970

APPROVED: A.W. Mulcan

DATE: Mar 20, 1970

NOTE: CONTOURS AT LOGARITHMIC INTERVALS 1.-1.5-2.-3.-5.-7.5-10

PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA A.W. MULCAN

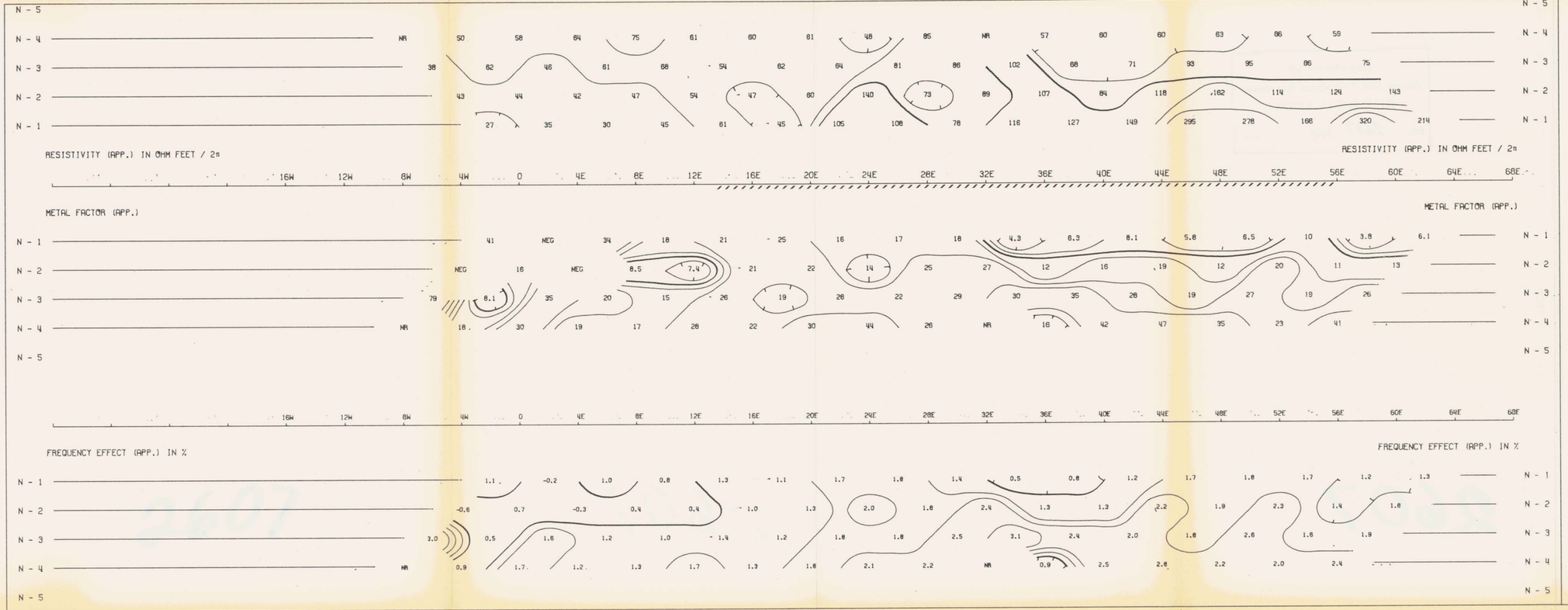
Expiry Date: May 28th, 1970

2607

McPHAR GEOPHYSICS

INDUCED POLARIZATION AND RESISTIVITY SURVEY

NOTE: THIS PLOT WAS PRODUCED WITH AN IBM 360/75 COMPUTER AND A CALCOMP PLOTTER



DWG. NO.- I.P.-5407-13

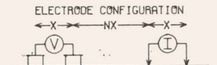
PHELPS DODGE CORPORATION OF CANADA LIMITED

RIVIERA OPTION, PROJECT 83

PORT HARDY AREA, NANAIMO M.D., B.C.

LINE NO.- 40S

ELECTRODE CONFIGURATION



SURFACE PROJECTION OF ANOMALOUS ZONES

DEFINITE

PROBABLE

POSSIBLE

FREQUENCIES: 0.31-5.0 CPS

DATE SURVEYED: FEB 1970

APPROVED: A.W. Mullan

NOTE: CONTOURS AT LOGARITHMIC INTERVALS 1.-1.5-2.-3.-5.-7.5-10

DATE: March 20, 1970

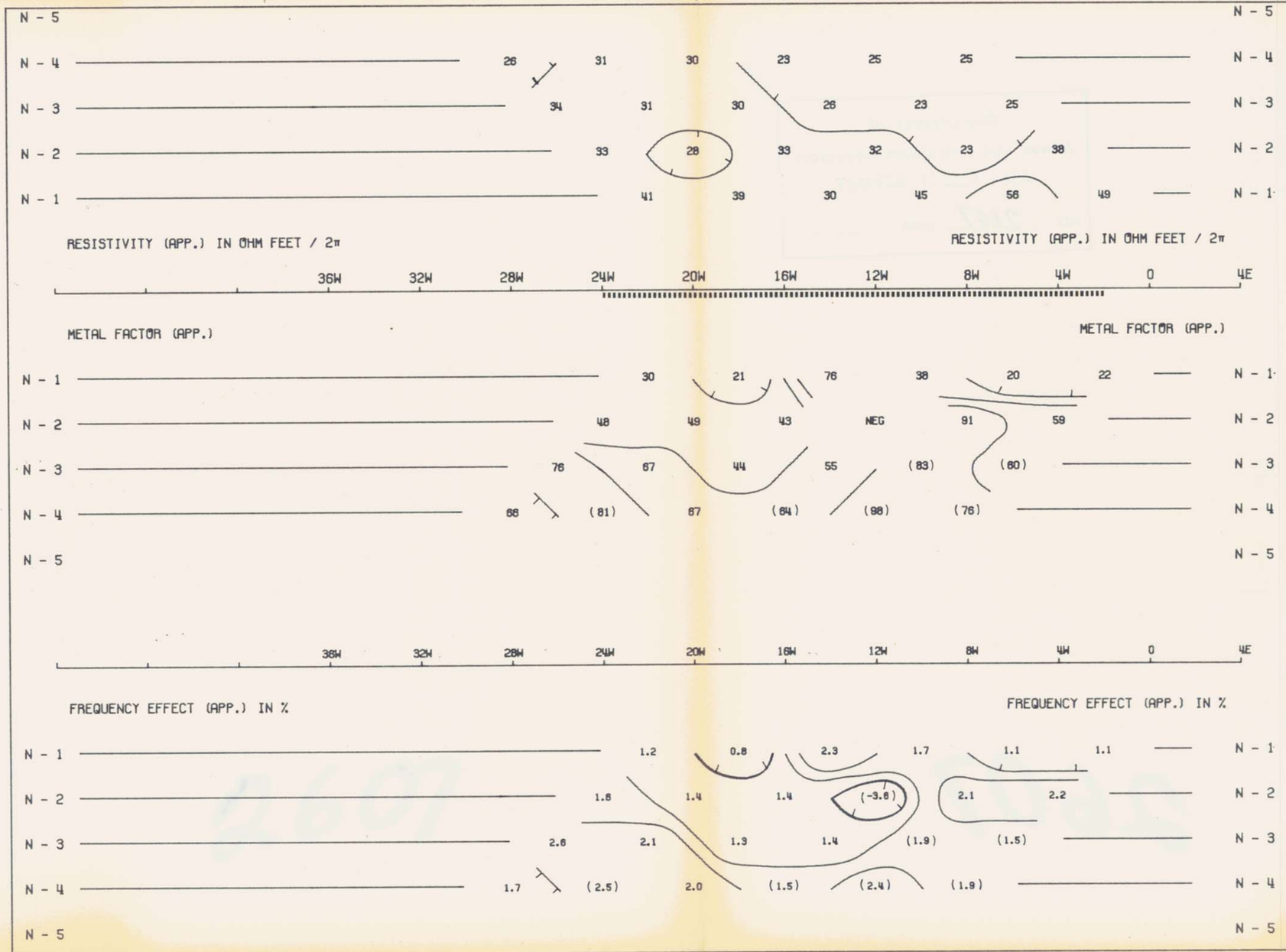
PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA A. W. MULLAN

2607

McPHAR GEOPHYSICS

INDUCED POLARIZATION AND RESISTIVITY SURVEY

NOTE: THIS PLOT WAS PRODUCED WITH AN IBM 360/75 COMPUTER AND A CALCOMP PLOTTER



DWG. NO.- I.P.- 5407-12

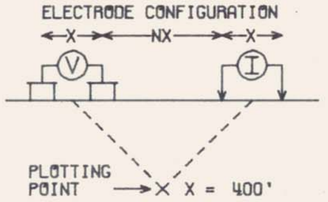
PHELPS DODGE CORPORATION OF CANADA LIMITED

RIVIERA OPTION, PROJECT 83

PORT HARDY AREA, NANAIMO M.D., B.C.

LINE NO.- 32S

ELECTRODE CONFIGURATION



SURFACE PROJECTION OF ANOMALOUS ZONES

DEFINITE ——————

PROBABLE ||||||||||||||||

POSSIBLE / / / / / /

FREQUENCIES: 0.31-5.0 CPS

DATE SURVEYED: JAN 1970

APPROVED:

NOTE: CONTOURS AT LOGARITHMIC INTERVALS 1.-1.5-2.-3.-5.-7.5-10

DATE: March 20, 1970

PROFESSIONAL ENGINEER PROVINCE OF BRITISH

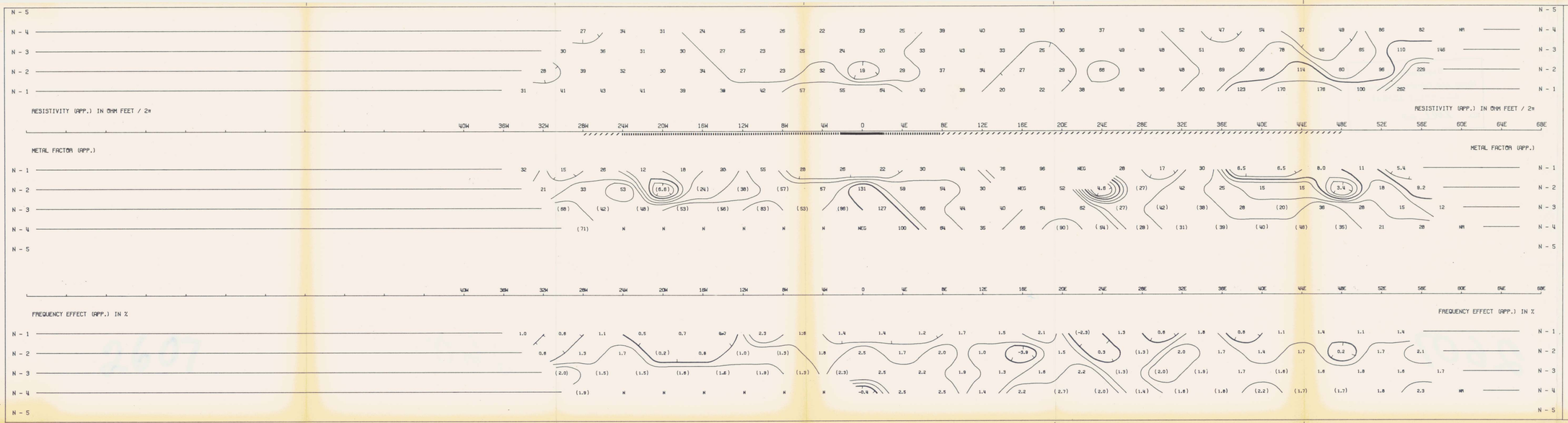
Expiry Date: May 28th, 1970

2607

McPHAR GEOPHYSICS

INDUCED POLARIZATION AND RESISTIVITY SURVEY

NOTE: THIS PLOT WAS PRODUCED WITH AN IBM 360/75 COMPUTER AND A CALCOMP PLOTTER



DWG. NO.- I.P.-5407-11

PHELPS DODGE CORPORATION OF CANADA LIMITED

RIVIERA OPTION, PROJECT 83

PORT HARDY AREA, NANAIMO M.D., B.C.

LINE NO.- 32S

ELECTRODE CONFIGURATION

SURFACE PROJECTION OF ANOMALOUS ZONES

DEFINITE

PROBABLE

POSSIBLE

FREQUENCIES: 0.31-5.0 CPS

DATE SURVEYED: JAN 1970

APPROVED:

DATE: Mar 26, 1970

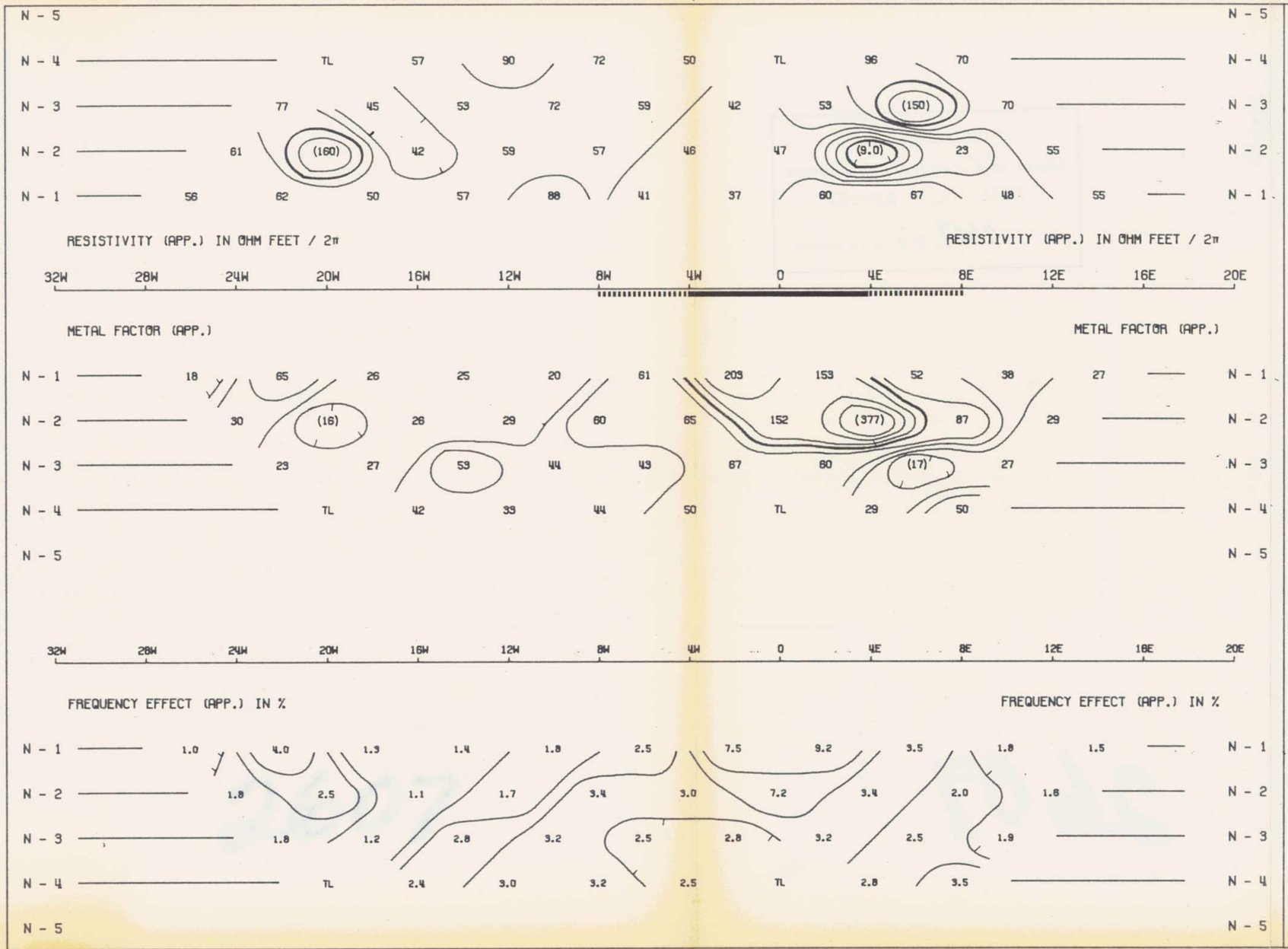
NOTE: CONTOURS AT LOGARITHMIC INTERVALS 1.-1.5-2.-3.-5.-7.5-10

2607

McPHAR GEOPHYSICS

INDUCED POLARIZATION AND RESISTIVITY SURVEY

NOTE: THIS PLOT WAS PRODUCED WITH AN IBM 360/75 COMPUTER AND A CALCOMP PLOTTER



DWG. NO.- I.P.- 5407-I

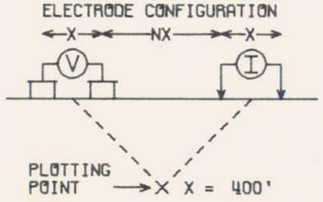
PHELPS DODGE CORPORATION OF CANADA LIMITED

RIVIERA OPTION, PROJECT 83

PORT HARDY AREA, NANAIMO M.D., B.C.

LINE NO.- 0

ELECTRODE CONFIGURATION



SURFACE PROJECTION OF ANOMALOUS ZONES

DEFINITE ——————

PROBABLE ||||||||||||||

POSSIBLE / / / / /

FREQUENCIES: 0.31-5.0 CPS

DATE SURVEYED: DEC 1969

APPROVED:

NOTE: CONTOURS AT LOGARITHMIC INTERVALS 1.-1.5-2.-3.-5.-7.5-10

DATE: May 20, 1970

PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA A. W. MULLAN

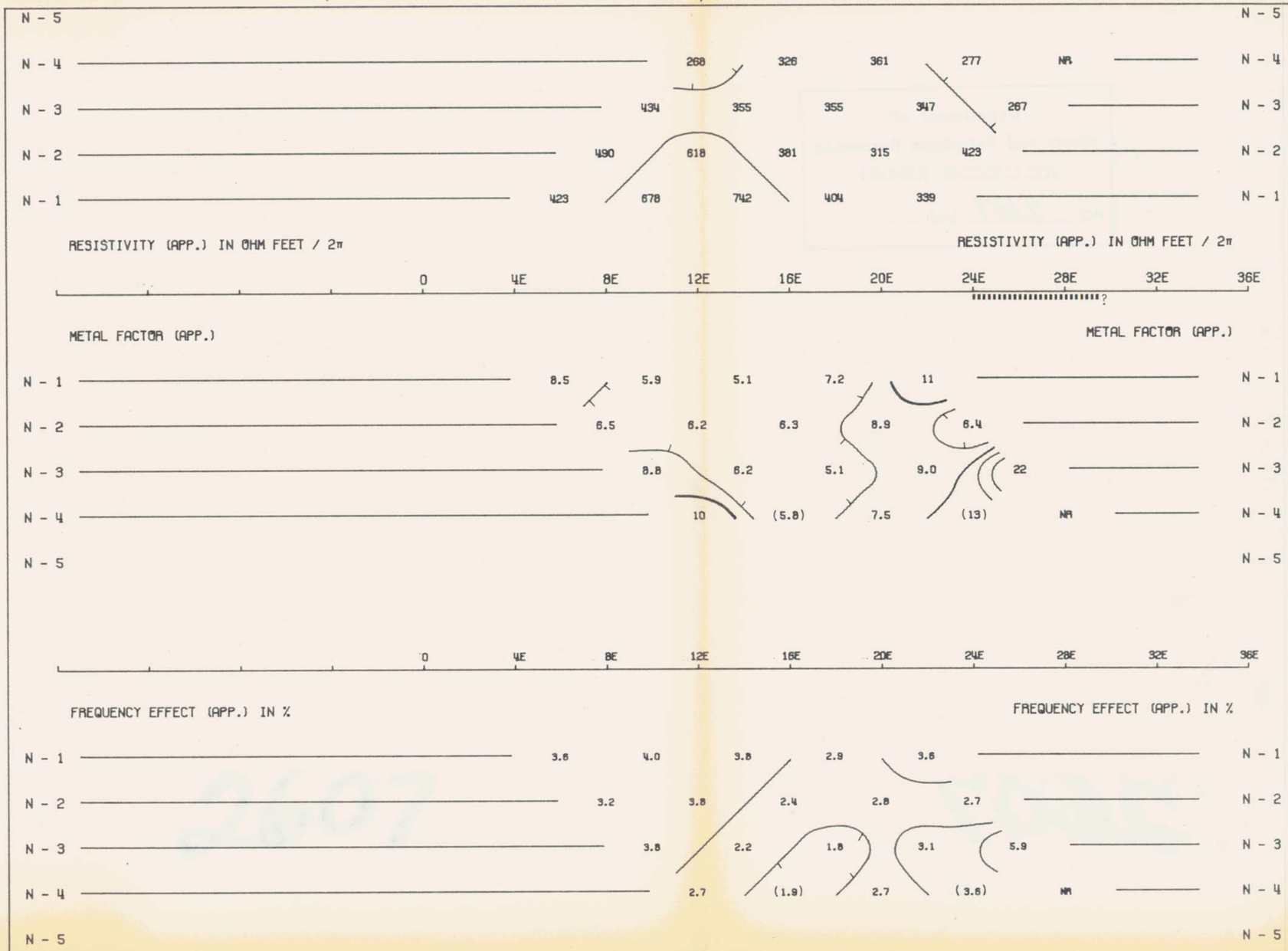
Expiry Date: May 28th, 1970

2607

McPHAR GEOPHYSICS

INDUCED POLARIZATION AND RESISTIVITY SURVEY

NOTE: THIS PLOT WAS PRODUCED WITH AN IBM 360/75 COMPUTER AND A CALCOMP PLOTTER



DWG. NO.- I.P.- 5407-15

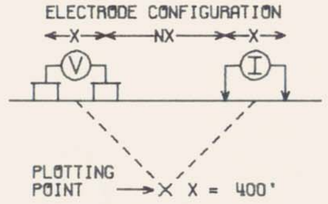
PHELPS DODGE CORPORATION OF CANADA LIMITED

RIVIERA OPTION, PROJECT 83

PORT HARDY AREA, NANAIMO M.D., B.C.

LINE NO.- 56S

ELECTRODE CONFIGURATION



SURFACE PROJECTION OF ANOMALOUS ZONES

DEFINITE ———

PROBABLE ||||||||||||

POSSIBLE ////////

FREQUENCIES: 0.31-5.0 CPS

DATE SURVEYED: JAN 1970

APPROVED: W. MacMillan

DATE: Mar 20, 1970

NOTE: CONTOURS AT LOGARITHMIC INTERVALS 1.-1.5-2.-3.-5.-7.5-10

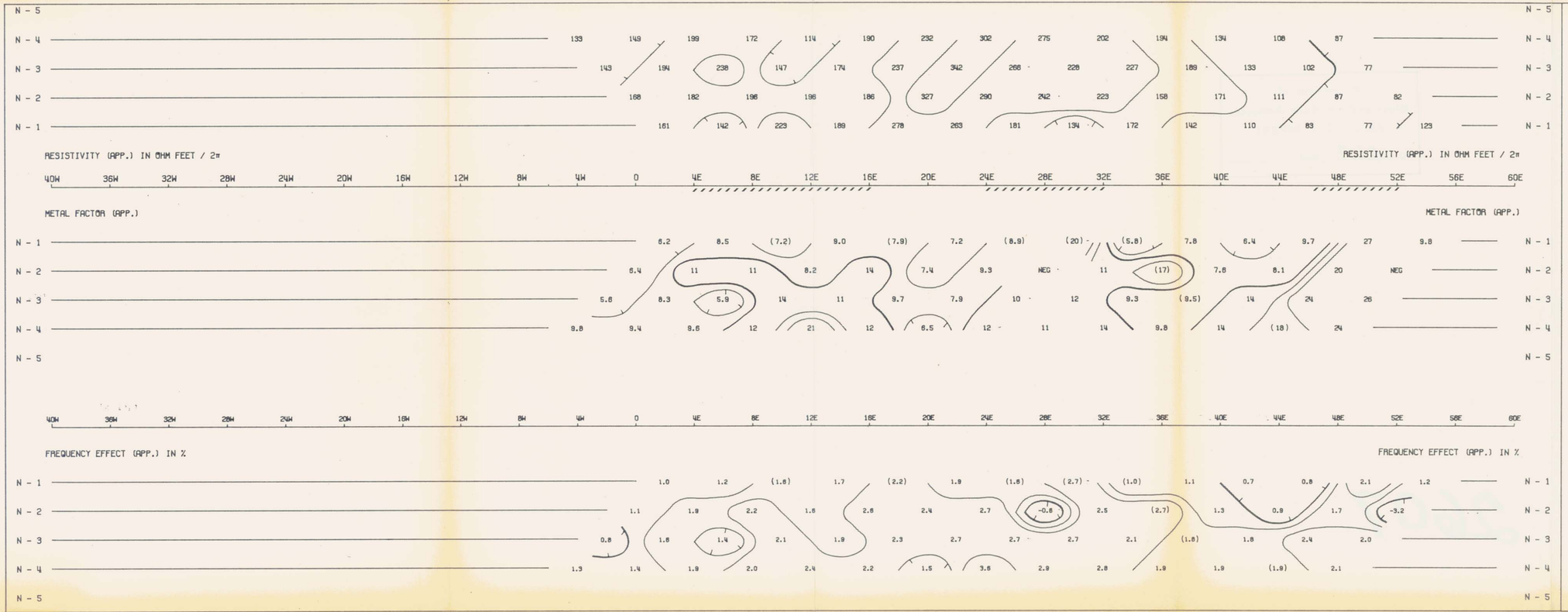
Expiry Date: May 28th, 1970

2607

McPHAR GEOPHYSICS

INDUCED POLARIZATION AND RESISTIVITY SURVEY

NOTE: THIS PLOT WAS PRODUCED WITH AN IBM 360/75 COMPUTER AND A CALCOMP PLOTTER



DWG. NO.- I.P.- 5407-14

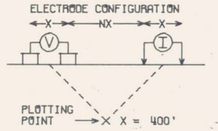
PHELPS DODGE CORPORATION OF CANADA LIMITED

RIVIERA OPTION, PROJECT 83

PORT HARDY AREA, NANAIMO M.D., B.C.

LINE NO.- 48S

ELECTRODE CONFIGURATION



SURFACE PROJECTION OF ANOMALOUS ZONES

DEFINITE

PROBABLE

POSSIBLE

FREQUENCIES: 0.31-5.0 CPS

DATE SURVEYED: JAN 1970

APPROVED:

A. W. McLEAN

DATE: Mar 20, 1970

NOTE: CONTOURS AT LOGARITHMIC INTERVALS 1.-1.5-2.-3.-5.-7.5-10

2607

McPHAR GEOPHYSICS

INDUCED POLARIZATION AND RESISTIVITY SURVEY

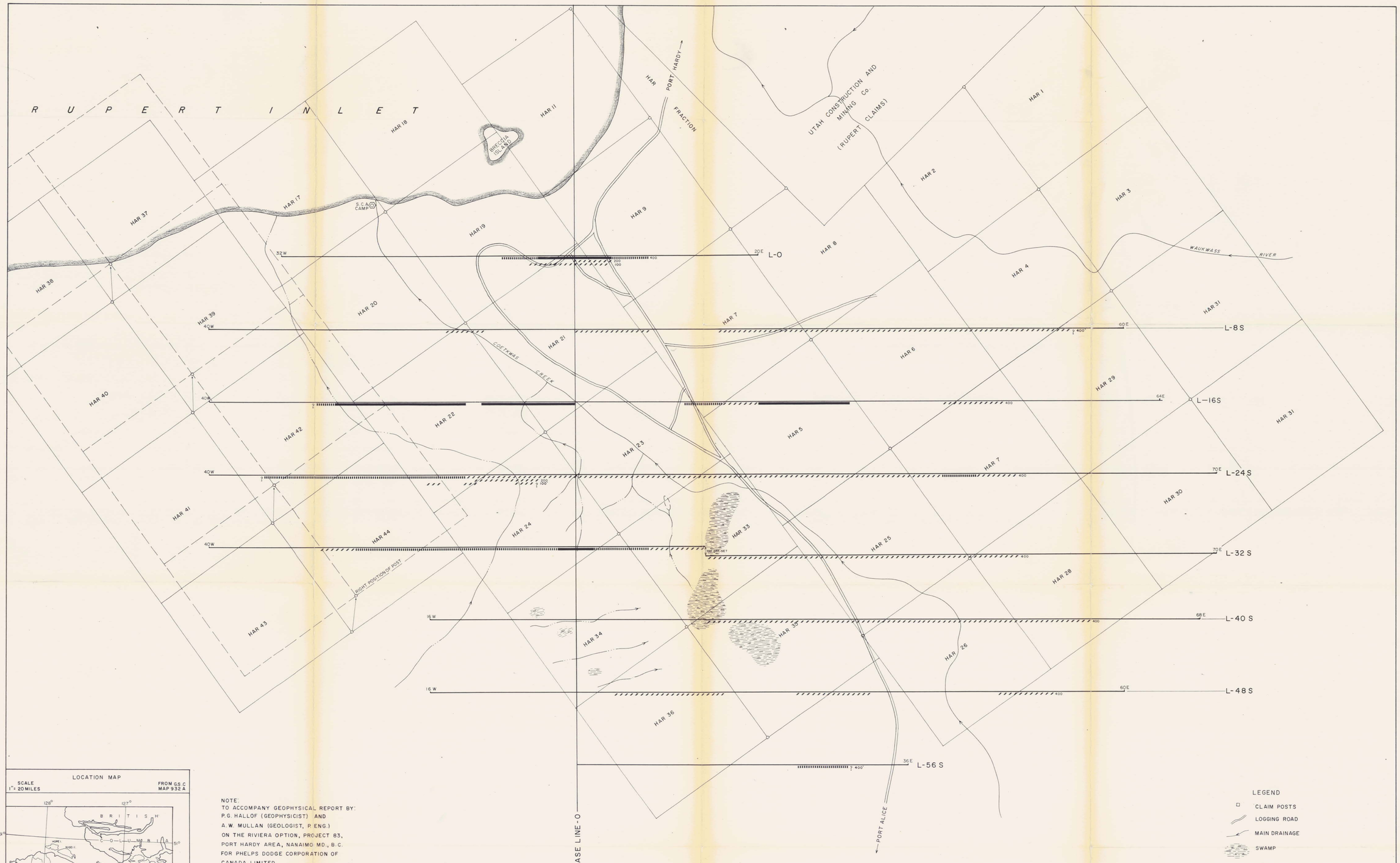
NOTE: THIS PLOT WAS PRODUCED WITH AN IBM 360/75 COMPUTER AND A CALCOMP PLOTTER

DWG. I.P.P. 4607

McPHAR GEOPHYSICS

INDUCED POLARIZATION AND RESISTIVITY SURVEY

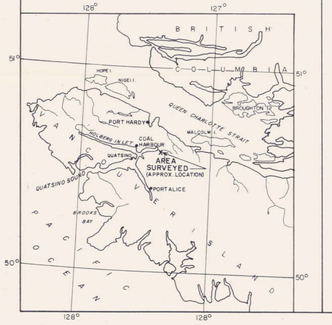
PLAN MAP



LOCATION MAP

SCALE 1" = 20 MILES

FROM G.S.C. MAP 932 A



NOTE:
TO ACCOMPANY GEOPHYSICAL REPORT BY:
P.G. HALLOF (GEOPHYSICIST) AND
A.W. MULLAN (GEOLOGIST, P. ENG.)
ON THE RIVIERA OPTION, PROJECT 83,
PORT HARDY AREA, NANAIMO M.D., B.C.
FOR PHELPS DODGE CORPORATION OF
CANADA LIMITED.
DATED: MARCH 19, 1970.

LEGEND

- CLAIM POSTS
- LOGGING ROAD
- MAIN DRAINAGE
- SWAMP

Department of
Mines and Petroleum Resources
ASSESSMENT REPORT
NO. 2607 MAP #1

N

SURFACE PROJECTION OF ANOMALOUS ZONES

DEFINITE ——————

PROBABLE ·····

POSSIBLE ?????

Number at the end of anomaly indicates spread used.

PHELPS DODGE CORPORATION OF CANADA, LIMITED

RIVIERA OPTION, PROJECT 83, PORT HARDY AREA, NANAIMO M.D., B.C.

SCALE

ONE INCH EQUALS FOUR HUNDRED FEET

2607

DRAWN: [illegible] 1970
DATE: [illegible] 1970
APPROVED: A.W. MULLAN
DATE: MAY 28/1970

PROFESSIONAL ENGINEER OF BRITISH COLUMBIA

Expiry Date: May 28th, 1970

DWG. I.P.P. 4607